

Classification of *Acacia Koa* and Relatives (Leguminosae) Hawaiian Plant Studies 93¹

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THE KOA TREE or one of its relatives is common in the Hawaiian Islands, usually forming the lower dry forest at the lower edge of the native mountain forests. There are fluctuations and variations within the group, hence the making of a good classification of them all is not easy.

Also there is an added source of confusion in the practice of reforestation. This is recorded on the label of Degener 30,103 of *Acacia kauaiensis*, "Study of natural distribution of koa species, vars. & forms now hopelessly confused as in 30's the Board of Agriculture and Forestry purchased seed from youngsters on all the islands & dumped all these different taxa into a common bin in Honolulu. When foresters wished seed for reforestation on any island, they received this mixture. Such taxa undoubtedly are hybridizing." This use of heterogeneous seed has certainly complicated the populations.

Nevertheless, the writer has now studied the collections of the koa group, and presents the following new classification.

In the 19th century, following Bentham (1842), the Hawaiian koa was either identified as *Acacia heterophylla*, of the Mascarene Islands or that species was considered its closest relative. The author made a point of collecting good material of *A. heterophylla* on Reunion Island, Mascarenes, and he observed significant differences in it from the Hawaiian tree. Subsequently J. Vassal (1969: 443–447) documented the differences between the two species.

More recently L. Pedley (1975:6–10) in a

monograph of the extra-Australian species of *Acacia* subgenus *Heterophyllum* has treated the whole problem. He accepted the Hawaiian trees as distinct from the Mascarene one. He accepted *A. kauaiensis* Hbd., and *A. koa* Gray, but to the latter he reduced all the published varieties, and *A. Koaia* Hbd., saying: "*A. koa* exhibits a wide range of variation in such characters as size of mature plants, persistence of juvenile foliage, size and shape of phyllodes and number of branches of the inflorescence. It might be possible to distinguish infraspecific taxa but if this is to be done then the study of herbarium material should be supplemented by field studies throughout the area of distribution of the species. In the Hawaiian Is. abrupt changes in topography, rainfall, and soils over short distances have probably led to the development of diverse ecotypes."

Pedley seems unaware of the botanical travels in Hawaii of W. Hillebrand and the years of full-time forestry studies in the field by J. F. Rock, of the explorations of O. Degener, and those by the writer. These botanists have done the field work better than anyone else is likely to do it now or in the future.

The drawings here presented show for each kind the variation in the shapes of the phyllodia. In each plate the common, usual shape is placed in the middle, while the uncommon extremes are put at the sides.

Unless otherwise indicated, all the specimens cited here are in the Bernice P. Bishop Museum, Honolulu.

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KEY TO SPECIES AND VARIETIES

- A. Sepals and petals free; calyx lobes tomentose; pods 15–20 cm long, 15–20 mm wide; seeds transverse in pod; phyllodes 12–21 cm long, 7–23 mm wide. Kauai..... *A. kauaiensis*.
- A. Sepals connate; petals connate; calyx lobes glabrous,
 - B. Pod 8–12 mm wide, 8–15 cm long, slightly curved; seeds longitudinal in the pod; phyllodia 7.2–13.5 cm long, 5–19 mm wide, slightly curved (or straight). All islands except Oahu..... *A. Koaia*.
 - B. Pod 16–27 mm wide, 8–31 cm long, straight; seeds transverse in the pod; phyllodia 15–26 cm long, 8–25 mm wide,
 - C. Phyllodia 15–26 cm long, 8–25 mm wide, arcuate; pod 16–27 cm long, 7.5–15 mm wide. All large islands..... *A. Koa*, var. *Koa*.
 - C. Phyllodia 12–18 cm long,
 - D. Phyllodia 12–13 cm long, 16–24 mm wide, slightly curved; pods 8–12 cm long, 16–27 mm wide. Oahu..... *A. Koa*, var. *waianaeensis*.
 - D. Phyllodia 14–18 cm long, 23–36 mm wide, mostly arcuate; pods 10–20 cm long, 18–31 mm wide. Hawaii..... *A. Koa*, var. *latifolia*.

Acacia kauaiensis Hbd., Fl. Haw. Is. 113, 1888; Rock, Terr. Haw., Div. For., Bot. Bull. 5:23, 26, pl. VII, 1919; Leguminous Pl. Haw. 33, pl. 14, 1920; Skottsberg, Göteborgs Bot. Trädgård, Meddel. 15:376–378, figs. 320–331, 1944; Pedley, Queensl. Herb., Contrib. 18:9–10, 1975.

Figures 1a, b, c, 2

HOLOTYPE: Kauai, *Kn[udsen]* 55 (B). Holotype destroyed.

There are numerous collections of this, all from Kauai.

REPRESENTATIVE COLLECTION: Kauai, edge of Waimea Canyon, 3 July to 18 August 1917, C. N. Forbes 854.K. NEOTYPE: Waimea Drainage, 1917, C. N. Forbes 817.K. (BISH).

Acacia Koa Gray, U.S. Explor. Exped., Bot. 1:480, 1854; Mann, Amer. Acad. Arts Sci., Proc. 7:165, 1867; Fl. Haw. Is., Essex Inst., Comm. 5:236, 1868; Hillebrand, Fl. Haw. Is. 112, 1888; Degener, Pl. Haw. Natl. Park 173–179, pl. 46, 1930; Rock, Indig. Trees Haw. Is. 173–177, pl. 65–66, 1913; Terr. Haw., Div. For., Bot. Bull. 5:20–21, pl. III–IV, 1919; Leguminous Pl. Haw. 25–30, pl. 10, 1920; Skottsberg, Göteborgs Bot. Trädgård, Meddel. 15:373–376, figs. 300–319, 1944; Neal, Gardens Haw. 408–411, fig. 171, 1965; Pedley, Queensl. Herb., Contrib. 18:7–9, 1975.

A. Koa Gray, var. *lanaiensis* Rock, Terr. Haw., Div. For., Bot. Bull. 5:21, 23, pl. V, 1919, as to syntype, Rock 8,028, not as to lectotype.

A. Koa Gray, var. *Weimeae* Hochr., Candollea 2:377, 1925.

Figure 3

LECTOTYPE: Sandwich (= Hawaiian) Islands, Oahu, on the mountains behind Honolulu, U.S. Exploring Expedition, Capt. Wilkes (κ).

ISOTYPES: (GH, US)

DISCUSSION: Normally the first and best set of the Wilkes Expedition collections is in the Smithsonian Institution, (US), but in this case the two specimens in (US) are labeled merely Sandwich Islands; and so likewise are those in (GH). Luckily, the isotype in (κ) bears better data, the one here selected as the lectotype is cited above, and the other one is marked “on the sides of Mt. Loa [= Mauna Loa] and Mt. Kea [= Mauna Kea].” This latter is doubtless the broad-leaved variety for Hawaii, var. *latifolia*.

A. Koa, var. *Koa*, as now defined, occurs on all the principal islands of the Hawaiian group.

REPRESENTATIVE COLLECTIONS: Kauai: Between Makana and Waiahuakua, Na Pali

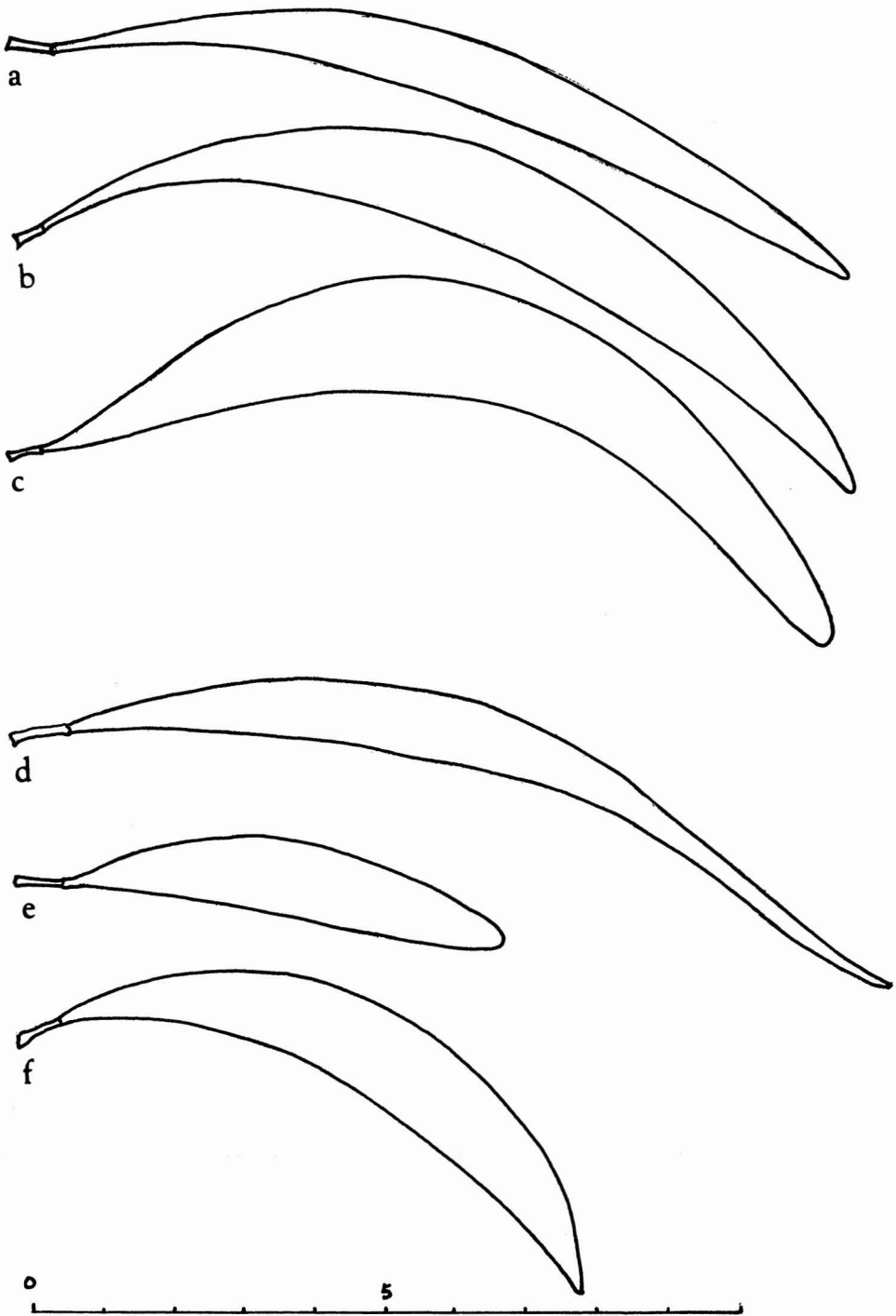


FIGURE 1. *Acacia kauaiensis* Hbd. *a*, narrow extreme, Kauai, Waimea Drainage, *Forbes* 1,073.K.; *b*, average shape, Waimea Drainage, *Forbes* 817.K.; *c*, wide extreme, Kokee, *Pearsall* 432a. *Acacia Koaia* Hbd. *d*, narrow extreme, Maui, Paunau-Kuhua divide, *St. John & Jones* 17,692; *e*, average shape, Lanai, Paomai (= Paoma), *Munro* 640; *f*, wide extreme, Hawaii, Hualalai, *Kondo*.

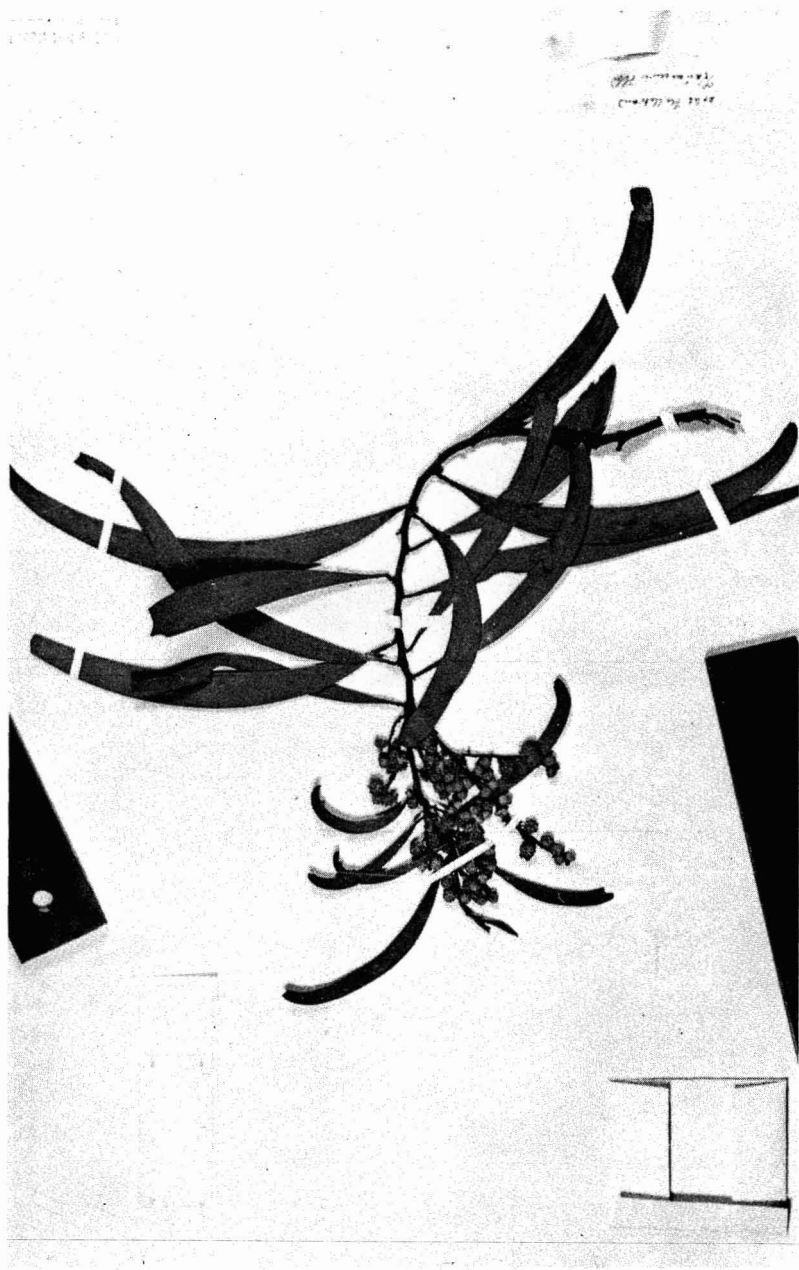


FIGURE 2. *Acacia kauaiensis* Hbd., from holotype, Kauai, 1855, Knudsen (B).

Trail, lower forest, 24 December 1939, O. Degener 17, 161.

Oahu: Koolau Range, ridge between Palolo Valley and Waialae Nui, dry ridge, 290 m alt., 3 August 1933, F. R. Fosberg 9,711.

Waianae Mts.: Mt. Kaala, Waianaeuka, 1,500 ft alt., 2 February 1930, E. Y. Hosaka 135.

Molokai: Near Mapulehu, April 1910, J. F. Rock 7,004.

Maui, east: Kaupo Gap, Crater of Haleakala, 10 August 1919, C. N. Forbes

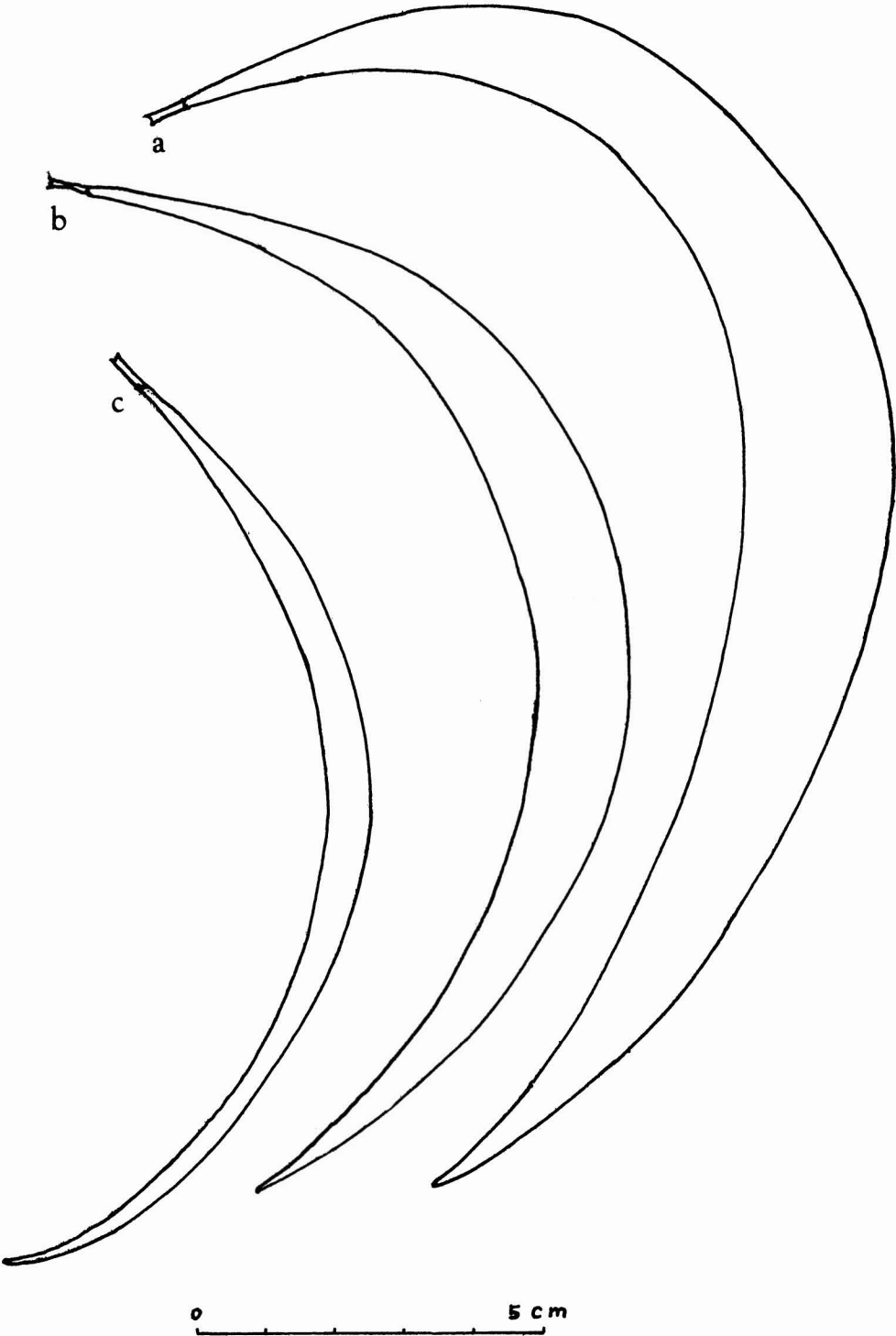


FIGURE 3. *Acacia Koa* Gray, var. *Koa*. *a*, wide extreme, Oahu, Kaiwikoele, Degener 30,485; *b*, average shape, Waikane-Schofield Trail, St. John 10,160; *c*, narrow extreme, Laie, Degener 20,400.

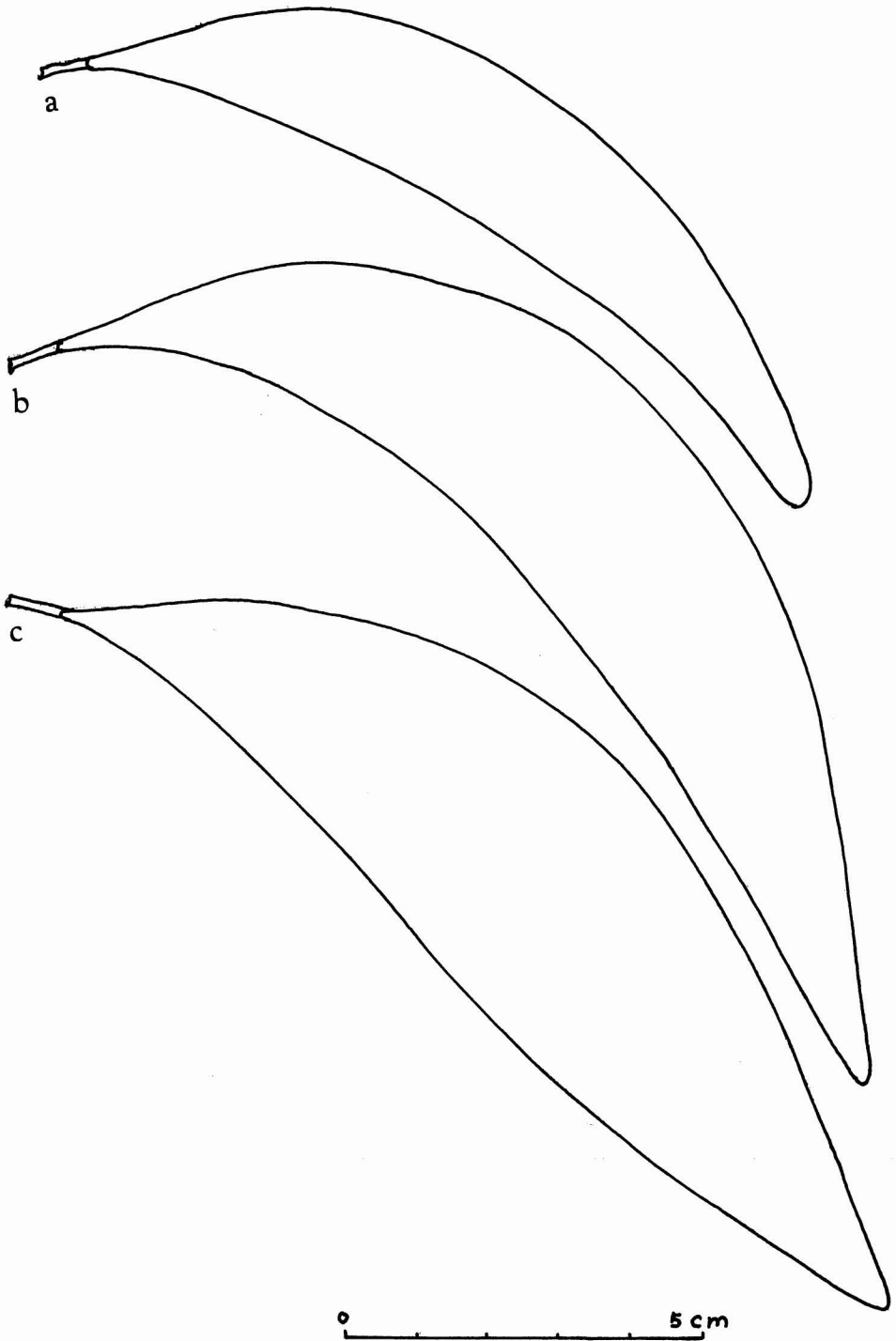


FIGURE 4. *Acacia Koa* Gray, var. *latifolia* (Benth.) St. John. *a*, narrow extreme, Hawaii, Hualalai, *Rock* 2,758; *b*, average shape, Hualalai, *Bryan* 30 July 1935; *c*, wide extreme, Kilauea, *Rock* 12,566.

1,119.M; west: Paunau-Kuhua divide, common on ridge, 19 December 1936, *H. St. John* & *S. B. Jones* 17,689.

Lanai: Lanaihale, southeast end, dry exposed area, 2,200 ft alt., 11 June 1974, *D. Herbst* & *G. Spence* 4,023.

Hawaii: Kau, slope of Mauna Loa above Pahala, 1,200 m alt., 19 September 1922, *C. Skottsberg* 589.

Acacia Koa Gray, var. *latifolia* (Benth.) comb. nov.

A. Koa Gray, var. *Hawaiiensis* Rock, Terr. Haw. Div. For., Bot. Bull. 5:23, 26, pl. VI, 1919; Leguminous Pl. Haw. 30, 33, pl. 11–13, 1920.

A. heterophylla Willd., ? var. *latifolia* Benth., Lond. J. Bot. 1:369, 1842.

REPRESENTATIVE SPECIMEN: Hawaiian Islands, Hawaii Island, Kilauea, Kau Desert, July 1915, *J. F. Rock* & *Copeland* 12,566 (isotype of var. *hawaiiensis*).

Figure 4

ORIGINAL DIAGNOSIS: “phyllodiis falcato-oblongis obtusissimis coriaceis. An species propria?—Owhyhee, on Mount Kaah, *Macrae*.”

HOLOTYPE: Hawaiian Islands, Owhyhee (= Hawaii) Island, on Mount Kaah (= Mauna Kea), Junio 1825, *J. Macrae* (BM). Type examined.

DISCUSSION: This is the abundant and dominant variety on Hawaii Island. It is a large and stately tree, growing in the wet rain forest, *Metrosideros* zone, or above it in the open high parkland zone. As testified by Rock (1920:30) this variety of the rain forest at from 4,000 to 6,000 feet altitude is a stately tree, attaining a height of 25–30 meters. Pedley seemed unaware of this, as for his *A. Koa*, an aggregate including all the varieties, he stated that it was a “Tree to ca 12 m tall...” (1975:7).

Acacia Koa Gray, var. *waianaeensis*, var. nov.

Figure 5

DIAGNOSIS HOLOTYPE: A specie differt in phyllodiis 10–15.5 cm longis 14–29 mm latis subcurvatis.

DESCRIPTION OF HOLOTYPE: Differing from the species by its phyllodia 10–15.5 cm long, 14–29 mm wide, only slightly curved; pods 8–12 cm long, 16–27 mm wide.

HOLOTYPE: Hawaiian Islands, Oahu Island, Waianae Mts., Dupont Trail, 2,800 ft alt., 30 December 1952, *Alvin K. Chock* 813 (BISH).

SPECIMENS EXAMINED: Hawaiian Islands, Oahu Island, Waianae Mts., Kealia, Kealia Trail, lower semiarid native forest, 1,750 ft alt., 8 January 1950, *A. K. Chock* 65 (HAW); Koolau Mts., Pupukea-Kahuku Trail, Paumalu, open dry koa forest, 340 m alt., 19 February 1933, *F. R. Fosberg* 9,207 (BISH, HAW); Waianae Mts., south of Ekahanui Gulch, C.C.C. contour trail, east slope of Puu Kaua, dry forest, 540 m alt., 3 May 1936, *Fosberg* 13,098 (BISH, HAW); Waianae Mts., Puu Kaala, Mokuleia, 2nd gulch east of Puu Kaupakulale, dry wooded ridge, 625 m alt., 23 October 1932, *Fosberg* & *St. John* 8,926 (BISH); Puu Hapapa Trail, dominant along the ridge, with *Psidium*, *Metrosideros*, *Styphelia*, 560 m alt., 19 February 1966, *Santa Gupta* 3 (HAW); lower eastern slopes of Mt. Kaala, behind Schofield Barracks, 6 February 1954, *C. H. Lamoureux* 57 (HAW); Waianae Range, ridge leading to Pohakea Pass, koa forest, 2,000 ft alt., 8 March 1953, *E. T. Ozaki* 362 (BISH, HAW); Kunia Firebreak Trail, moderately open area, 1,500 ft alt., 28 December 1960, *R. Sakai* 48 (HAW); Waianae Mts., Pu'u Ka'ala, Dupont Ridge Trail, dry lowland forest, 500–750 ft alt., 20 December 1959, *B. C. Stone* 3,161 (BISH); Kunia Firebreak Trail, in high slightly dense areas, 2,100 ft alt., 20 December 1960, *R. T. Tsuda* 7 (HAW).

DISCUSSION: These localities are all in the Waianae Mountains, except for one at Paumalu, at the north end of the Koolau Range. The new epithet is formed from the name of the type locality, Waianae, and *-ensis*, the Latin adjectival suffix.

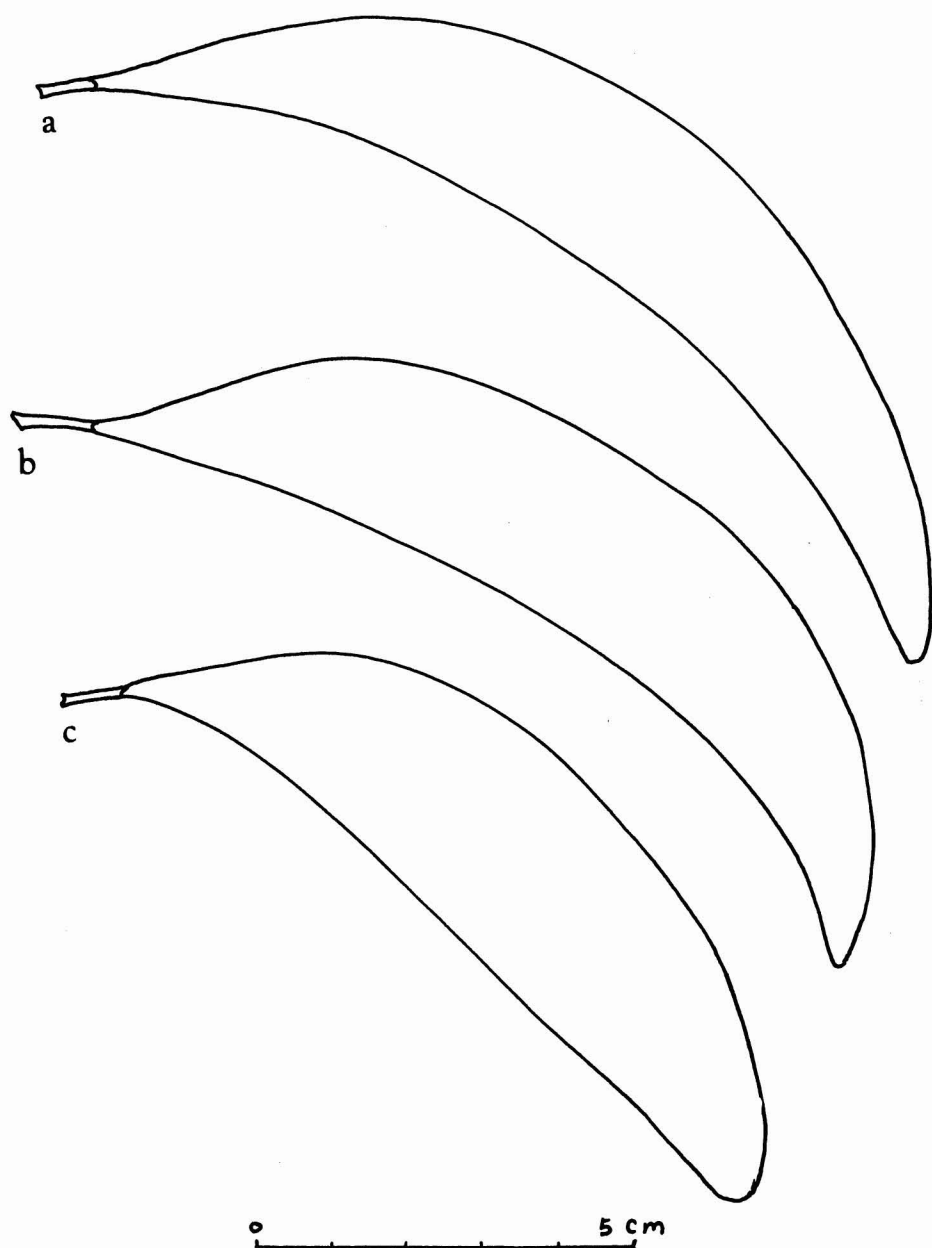


FIGURE 5. *Acacia koa* Gray, var. *waianaeensis* St. John. *a*, narrow extreme, Puu Kaala, Stone 3,161; *b*, average shape, Dupont Trail, Chock 813; *c*, wide extreme, Puu Kaua, Fosberg 13,098.

Acacia Koaia Hbd., Fl. Haw. Is. 113, 1888; Rock, Indig. Trees Haw. Is. 177, 181, 1913; Terr. Haw., Div. For., Bot. Bull. 5:29-30, pl. VIII, 1919; Leguminous Pl. Haw. 34-35, pl. 15, 1920; Degener, Fl. Haw. Fam. 169a: ill., 11 May 1937; Neal,

Gardens Haw. 405, 1965; Pedley, Queensl. Herb., Contrib. 18:7, 1975, the latter reducing it to *A. Koa*.

NOM. VERN.: "koai'a" or "koai'e" (Hawaiian language).

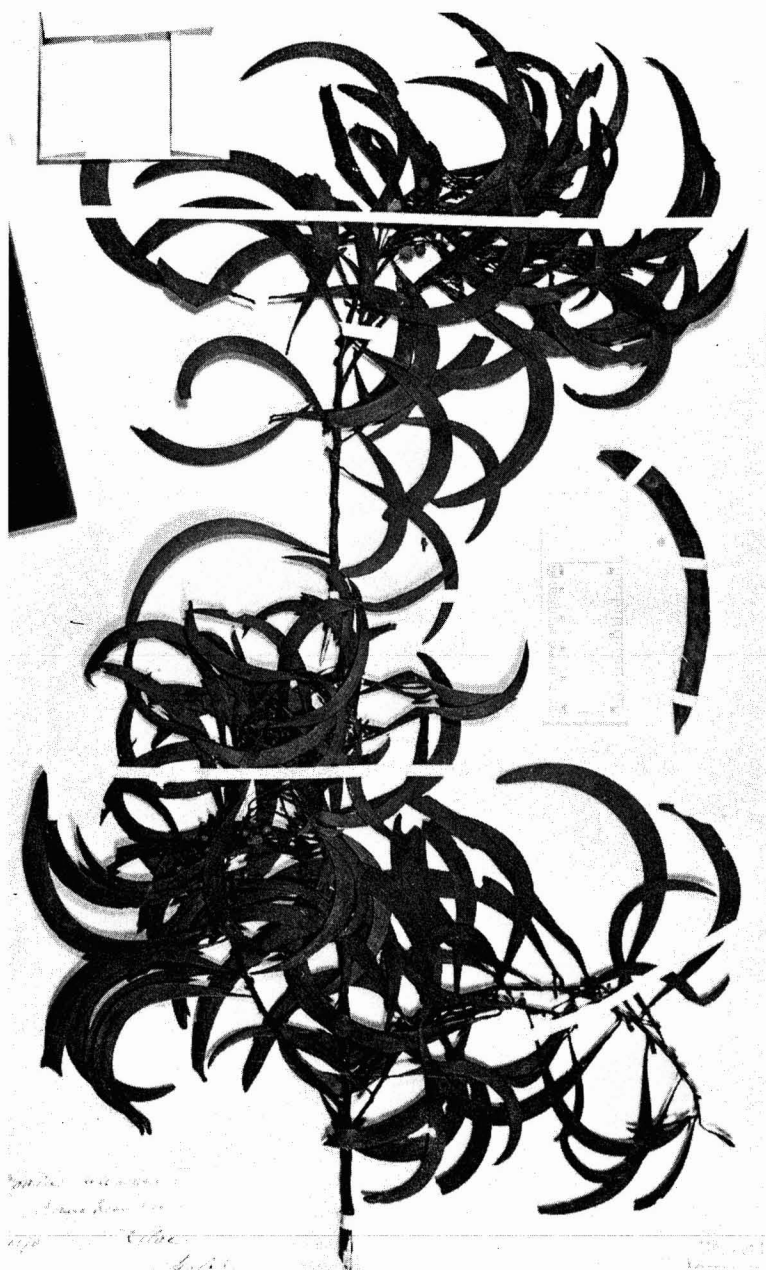


FIGURE 6. *Acacia Koaia* Hbd., lectotype, Molokai, Kalae, June 1870, *W. Hillebrand* (B). Photograph taken in 1935; lectotype now destroyed.

Figures 1*d*, *e*, *f*, 6

LECTOTYPE: Hawaiian Islands, Molokai Island, Kalae, July 1870, *W. Hillebrand* (B). Type destroyed, but see our Figure 6, photographed in 1935. Type examined.

A good and detailed description of this tree is given by Degener in his *Flora Hawaiensis*.

Since many more collections are now available, they are here listed. The species

still occurs, though less frequently, on dry land habitats, mostly on the leeward side of the islands and below 3,500 feet altitude. Unless otherwise stated, the specimens cited are all in the Bernice P. Bishop Museum, Honolulu.

SPECIMENS EXAMINED: Kauai Island: Lihue, near Gap, 8 July 1909, *C. N. Forbes* 17.K; Nonou Mts., 16–17 October 1916, *Forbes* 596.K; south rim of Waimea Canyon, near Haeleele Entrance, 24 September 1968, *R. W. Hobdy*; Kaholuamano, October 1911, *J. F. Rock* 17,159 and 17,160.

Molokai Island: west slope of west fork of upper Onini Gulch, 2,500 ft alt., 21 January 1973, *L. E. Bishop* 1,689 (HAW). Rock's collection is now redetermined as *A. Koa*.

Maui Island: Kamole, south slope of Haleakala, 21 December 1948, *O. Degener* 19,291; Olinda, 26 March 1952, *Degener* 22,110; Kealia Forest, south slope of Haleakala, 28 March 1920, *Forbes* 2,117, 2,119, and 2,127; Paunau-Kuhua Divide, 19 December 1936, *H. St. John & S. B. Jones* 17,692.

Lanai Island: Koala Gulch, 11 June 1974, *D. Herbst & G. Spence* 4,030; southeast Palawai Basin, 3 June 1927, *G. C. Munro* 44 and 45; 3 November 1913, 78; 8 November 1913, 193; 27 August 1920, s.n.; 19 April 1926, s.n.; Mahana, 22 September 1913, 109; Paomai (= Paoma), August 1918, 672 and October 1917, 640.

Hawaii Island: North Kohala, 15 May 1956, *L. W. Bryan*; Kamuela, 28 July 1966, *S. Carlquist* 2,078; Kamuela, November 1960, *H. F. Clay*; Kawaihaeuka, 9 January 1952 and 21 January 1959, *C. J. Davis*; Kamuela, 22 March 1930, *O. Degener* 3,899; Puuwaawaa, May 1932, *Degener* 7,253; Puu Kawaiwai, 10 October 1961, *F. R. Fosberg* 42,127; Kohala Mt., December 1972, *W. Hillebrand & J. M. Lydgate*; Hualalai, 20 July 1946, *Y. Kondo*; Kohala, roadside, 30 December 1954, *C. H. Lamoureux* 473 (HAW); Puuwaawaa, May 1932, *A. Meebold*; Puu Kawai, Waimea, 24 July 1909, *J. F. Rock* 3,982, 3,984, and June 1910, 8,346; Puuwaawaa, 10 November 1922, *C.*

Skottsberg 1,112; Parker Ranch, 3 January 1946, *Suzuki*; Puuwaawaa, 29 December 1954, *H. A. Woolford*.

DISCUSSION: The species was previously known on Molokai. It occurs in a low, dry zone, below the Koa zone, in regions now largely urbanized or with an altered and exotic vegetation. However, it still occurs on the western side of Hawaii, in Puuwaawaa, and near Waimea, and there is a little of it on Lanai. There is no evidence of its having been on Oahu.

H. Mann, in his *Flora of the Hawaiian Islands* (1868:236) does not accept or list *A. Koaia*, but he refers to it under *A. Koa*: "the variety on the mountains with harder wood and broader phyllodia is called 'Koaie.'"

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